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AN ANTENNA ENGINEERING HANDBOOK FOR ARMY AND MARINE FIELD COMMUNICATION APPLICATIONS

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An Antenna Engineering Handbook for Army and Marine Field Communication Applications*

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I. INTRODUCTION

There is currently interest in modeling various antennas chosen to be used in field communication scenarios in the HF range by both the Army and Marine Corps. An engineering antenna handbook and computer database program has been produced at LLNL which will be used in producing an ultimate field antenna handbook. This final handbook will include additional material concerning ease of practical construction besides the technical data provided by LLNL. A host of antenna types and configurations have been studied for characteristics which can be used for optimizing best performance when interfaced with existing propagation codes and models. A parameter variation study has been undertaken with frequencies varied from 2 to 30 MHz. and ground conductivities and dielectric constants varied for all possible ground conditions. Antenna parameters such as length, height, number of wires, ground stake length, and screen radius variation about some nominal have been looked at. Figures of merit have been devised for both surface and sky wave propagation. Various ways of presenting final results have been explored such as tables, graphs, databases, and parametric lookup tables.

II. BACKGROUND

The goals of this study were to construct an engineering antenna handbook by presenting electrical performance data on an appropriate set of antenna configurations and parameters. The following set of antenna model configurations have been analyzed and are included in the handbook: Whips with and without Radio, Basic Half Squares, Inverted Half Squares, Reduced-

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height (folded) Half Squares, 3-element Half Squares, Inverted 3-element Half Squares, Horizontal Vee Beams, Sloping Vee Beams, Sloping Vee Beams, legs terminated, Horizontal Dipoles, Inverted-Vee Dipoles, Horizontal Square Loops (Quads), Vertical Triangular Loops (Delta Loops), Basic Longwires, Sloping Longwires, and Inverted-Vee Longwires.

III. RESULTS

The soldier in the field needs to select an antenna that meets his need for providing reliable communication and also one which is easy to construct for meeting this need. Given some known receiving and transmitting antennas and some known transmitter power and receiver signal-to-noise characteristics at the command site and the ionospheric data between the path (sky wave) or terrain data (surface wave), propagation codes will predict the range of take-off angles and the minimum gain (dB above an isotropic radiator) at each angle needed at the field site to provide communication to some statistical reliability factor. The selection process would then be to select an antenna from one's catalog of all possible types and configurations which either meet or exceed the gain values needed for reliable communication.

We have also formulated a new method of analysis for writing out the current as solved by NEC [1] for each antenna configuration to a database file and using this file to interactively make field calculations and pattern plots. This extra degree of freedom will let us calculate a field anywhere we wish in a much shorter period of time. The program will have the ability to access many current files (data base) so that it would be easy to compare patterns of different antennas to quickly realize their differences.

IV. CONCLUSIONS

Representative results from this work are shown in Figure 1 for Sky wave radiation patterns for some selected angles of elevation. The Sky wave azimuth pattern is shown for each of the elevation angles chosen (10 degree increments). Also shown is the elevation pattern corresponding to the azimuth angle where the gain is a maximum for that particular elevation angle. In this manner, one can more effectively visualize the 3-D characteristics of the radiation pattern oriented for maximum communication efficiency. An example of the tabular format of output is shown in Table 1 for a selected class of antennas sorted by maximum gain in azimuth at an elevation angle of 30 degrees. The interactive computer program can easily rearrange this table by sorting any specific column of interest. These and other results will be discussed and shown in this paper.

REFERENCES

[1] G. J. Burke and A. J. Poggio, "Numerical Electromagnetics Code - Method of Moments", NOSC TD 116, NOSC, San Diego, CA, Jan. 81